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SERIOLA CARPENTERI, A NEW SPECIES OF AMBERJACK (PISCES: CARANGIDAE) FROM TROPICAL WESTERN AFRICA[1]

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Seriola carpenteri, a new species of amberjack from the eastern Atlantic, is described and compared with its congeners. This species is very similar to its zoogeographical counterpart in the eastern tropical Pacific, *S. peruana* Steindachner. Among the Atlantic species, it is intermediate between *S. dumerili* (Risso) and *S. rivoliana* Cuvier in many characters.

Seriola carpenteri new species

Figure 1

Guinean amberjack

Synonymy: No previous author has recognized the distinctiveness of this species. It has previously been misidentified as *S. fasciata*, *S. lalandi* and *S. dumerili*, as noted below.

Seriola fasciata, Fowler, 1919: 228 (USNM 42320, 13 specimens 80–100 mm standard length (SL) from 06°38′ N, 13°40′ W). Fowler, 1936: 679 (USNM 42320 re-recorded).

Seriola lalandi, Postel, 1950: 67, photo 18, schémas 23–24 (five specimens 687–832 mm SL from vicinity of Cape Verde). Williams, 1968: pp. 223–254 (part).[2]

Seriola dumerili, Cadenat, 1950: 167, fig. 97 (mostly 500–700 mm, markets, Senegal) (probably *S. carpenteri*, data insufficient to confirm identity). Furnestin et al., 1958: 447, fig. 51 (one specimen 602 mm

[1] Contribution No. 2559 from the Woods Hole Oceanographic Institution.

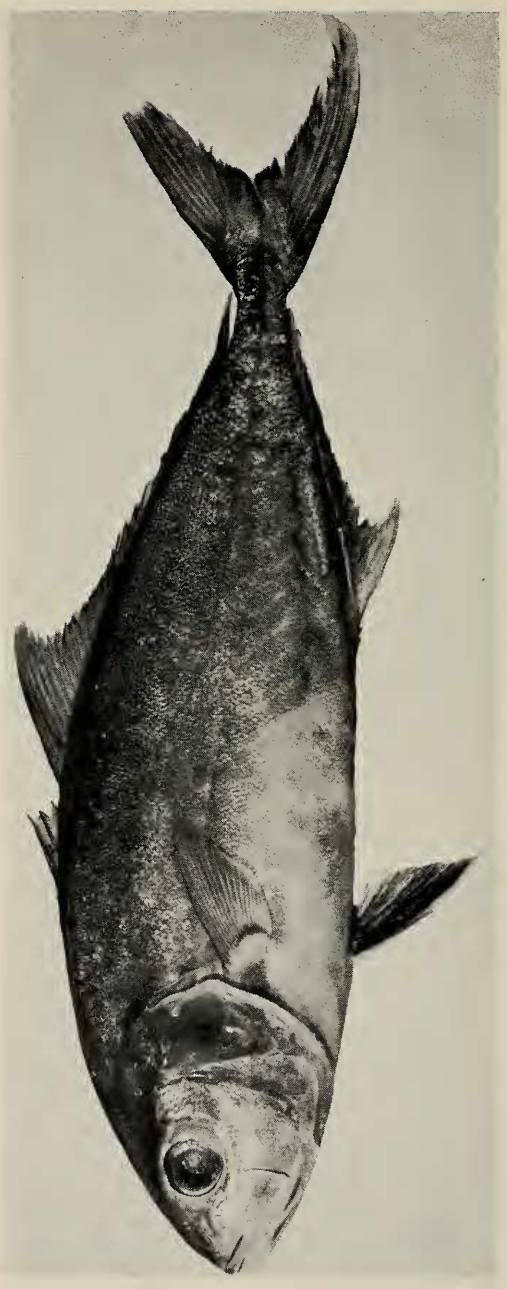

FIG. 1. *Seriola carpenteri*, holotype, 437 mm SL, Luanda, Angola, USNM 205000 (formerly TABL 103725).

total length from between Agadir and Cape Rhir, Morocco, identified as S. *carpenteri* from figure). Williams, 1968: pp. 223–254 (part).[2]

Holotype: U.S. National Museum (USNM) 205000; formerly Tropical Atlantic Biological Laboratory (TABL), National Marine Fisheries Service, 103725, mature male of 437 mm SL. Specimen purchased at fishing boat docks, Luanda, Angola (latitude 8°47′ S), by George C. Miller on 29 February 1968; presumably caught in local waters.

Description of holotype: Counts: Dorsal VII-I, 32. Anal II-I, 20. Pectoral (both sides) I, 19. Pelvic (both sides) I, 5. Gill rakers 8 upper (including raker at angle of arch), 14 lower, including two rudiments at anterior end of lower limb. Vertebrae 10 precaudal, 14 caudal.

Measurements were taken as defined by Hubbs and Lagler, 1958 (*) and Marr and Schaefer, 1949 (†) with modifications and additions. For many measurements, these definitions differ in wording only. The "origin" of Hubbs and Lagler is equivalent to the "insertion" of Marr and Schaefer. Hubbs and Lagler's "height" of the the second-dorsal and anal fins is called "length" by Marr and Schaefer. The terms "pelvic" (fin) and "upper jaw" of Hubbs and Lagler correspond to "ventral" and "maxillary" of Marr and Schaefer. The "eye" of Hubbs and Lagler is the same as the "iris" of Marr and Schaefer. In the following measurements, total length was taken as in Hubbs and Lagler, but without squeezing the caudal rays together, and fork length as the "total length" of Marr and Schaefer, but without depressing the fleshy flap at the posterior margin of the caudal. Head length was taken as in Hubbs and Lagler, without depressing the fleshy flap at the posterior margin of the opercle. Body width (maximum) always occurred at or near the insertion of the pectorals, and was only slightly, if at all, greater than the "head width" of Hubbs and Lagler. The base of the first dorsal was measured as the length of the slot into which that fin folds. Except in large individuals this is the same as the method of Marr and Schaefer. Snout to insertion of anal, height of anal, and length of anal base were measured as in Hubbs and Lagler, except that the insertion of the anal fin was arbitrarily taken to be the point where the posterior edge of the second anal spine meets the ventral profile. The first two spines of the anal fin are attached to the main part of the fin by membrane in small (less than 50 mm) *Seriola*, but become detached with growth of fish; the first or both may be subcutaneous in large individuals. Diameter of orbit is used in preference to "length of orbit" of Hubbs and Lagler, but is the same measurement. Additional measurements were made as described in the following presentations.

Measurements (in mm followed by % SL in parentheses): SL 437. Fork length 474 (108.5). Total length* 541 (123.8). Head length* 135 (30.9). Body depth*† [maximum near middle of base of first dorsal]

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[2] I have examined 19 *Seriola* specimens from the Guinean Trawling Survey (see list of paratypes) and all were S. *carpenteri*, but it is, of course, possible that other species of *Seriola* were taken.

125 (28.6). Body width [maximum] 64 (14.6). Depth at posterior margin of opercle 118 (27.0). Depth of caudal peduncle*† 18.8 (4.30). Length of caudal peduncle [average of distances from caudal pits to terminations of second-dorsal and anal fins] $\frac{25.2 + 26.8}{2} = 26.0$ (5.96). Width of caudal peduncle [at mid-length] 26.6 (6.08). Snout to insertion of pectoral 137 (31.4). Snout to insertion of first dorsal† 175 (40.0). Snout to insertion of pelvic† 143 (32.7). Snout to insertion of second dorsal† 217 (49.7). Snout to insertion of anal 280 (64.1). Longest first dorsal spine*† [4th] 27.6 (6.32). Length of first dorsal base 43.8 (10.0). Height of second dorsal*† 77.2 (17.6). Length of terminal second-dorsal ray* 26.4 (6.05). Length of second-dorsal base*† 201 (46.0). Height of anal 60.7 (13.8). Length of terminal anal ray* 29.3 (6.71). Length of anal base 117.4 (26.9). Length of pectoral fin*† 76.4 (17.5). Length of pelvic fin* 81.6 (18.7). Spread of caudal 111 (25.3). Length of upper caudal lobe from dorsal pit 135 (30.9). Length of lower caudal lobe from ventral pit 132 (30.2). Insertion of pelvic fin to vent 114.5 (26.2). Tip of pelvic fin to vent 26.9 (6.15). Snout length* 48.6 (11.2). Length of upper jaw*† 58.9 (13.5); upper jaw reaches to perpendicular through mid eye. Maximum vertical width of upper jaw 21.2 (4.85). Maximum height of supramaxillary 6.5 (1.49). Width of fleshy interorbital [between dorsal margins of orbits] 46.5 (10.6). Diameter of bony orbit 32.6 (7.46). Diameter of fleshy orbit* 26.1 (5.98). Diameter of eye*† 24.0 (5.49). Orbit to angle of preopercle* 50.9 (11.6). Longest gill raker 22.5 (5.15). Maximum girth 312 (71.4). Testes [both sides] 90×13 (20.6×29.7).

Dentition: Vomer arrow-shaped with an elongated shaft tapering posteriorly, covered with granular teeth. Palatine and pterygoid dentition consisting of bands of granular teeth with a few irregular small patches between them on each side. Upper and lower jaws with bands of granular teeth broader anteriorly, tapering posteriorly. Tongue slender with median bands of granular teeth and an irregular pattern of similar teeth laterally.

Paratypes: USNM 42320, 06°38′ N, 13°40′ W, 21 Oct. 1889, 13 specimens (80–100 mm SL), USS *Eclipse*, collector H. W. Brown. Museum National d'Histoire Naturelle, Paris (MNHN), Laboratoire des Pêches Coloniales, French West Africa (682). MNHN 1967-834, 06°05′ N, 01°38′ E, 2 (179–186). Woods Hole Oceanographic Institution (F. J. Mather 454), 04°55′ S, 11°38′ E, 1 March 1967, trawl at 75 meters (190), *Ombango*. Nineteen specimens from the Guinean Trawling Survey (Williams, 1968), of which 17 were collected by trawl at the depths indicated, or between those depths and the surface, and two were dip netted at surface as follows: TABL 107362, 09°24′ N, 15°26′ W, 28 November 1963, surface (dip net) (115 mm SL); TABL 107361, 07°54′ N, 13°56′ W, 19 November 1963, 30 meters, 2 (135–144); TABL 107360, 07°32′ N, 13°21′ W, 17 November 1963, 200/210 meters

(180); TABL 107356, 05°43′ N, 10°22′ W, 6 November 1963, 100 meters, 2 (101–109); TABL 107358, 05°39′ N, 00°14′ E, 27 February 1964, 30 meters (250); TABL 107357, 05°38′ N, 00°14′ E, 25 February 1964, 40 meters, 2 (202–203); TABL 107359, 05°12′ N, 04°53′ E, 31 March 1964, 105 meters (160); USNM 205001, 09°24′ N, 15°26′ W, 28 November 1963, surface (dip net) (145); USNM 205002, 04°44′ N, 00°53′ W, 5 September 1963, 50 meters (182); USNM 205003, 03°06′ N, 09°43′ E, 19 April 1964, 40 meters, 2 (192–199); USNM 205004, 03°05′ N, 09°42′ E, 19 April 1964, 50 meters (209); USNM 205005, 01°13′ N, 09°14′ E, 29 April 1964, 50 meters, 2 (180–199); USNM 205006, 02°34′ S, 09°38′ E, 16 May 1964, 30 meters (191); USNM 205007, 02°41′ S, 09°32′ E, 16 May 1964, 50 meters (219). The data for USNM 205004 and 205006 may have been interchanged.

Description: Counts: First dorsal VII (8 specimens) or VIII (28) in individuals 80–440 mm SL, decreasing externally to VI or V in larger individuals. Pterygiophores below first dorsal spines 7 (32), 8 (2). Supraneurals 3 (34). Second dorsal I, 28 (3), I, 29 (5), I, 30 (9), I, 31 (12), I, 32 (7), I, 33 (1). Pterygiophore below first element of second dorsal between 5th and 6th neural spines (34). Anal II-I, 19 (10), II-I, 20 (27). Pectoral I, 18 (1), I, 19 (11), I, 20 (4), I, 21 (2). Pelvic I, 5 (9). Gill rakers [specimens 80–250 mm SL]: upper 7 (14), 8 (21), 9 (1), 10 (1); lower 15 (6), 16 (21), 17 (8); total 22 (5), 23 (7), 24 (7), 25 (5), 26 (1). Rudimentary gill rakers (included with above counts): upper 0 (30), 1 (5); lower 0 (10), 1 (13), 2 (10), 3 (2); total 0 (11), 1 (10), 2 (12), 3 (2), 4 (1); [437 mm] 8 + 14 (2 lower rudiments); [682 mm] 8 + 16 (1 upper and 2 lower rudiments). Vertebrae 10 precaudal + 14 caudal = 24 (34).

As in other *Seriola* species, the number of external first dorsal spines often decreases as the fish attain large sizes, because one or more of the terminal spines may become subcutaneous in older fish. The largest specimen examined (682 mm SL) had 5 external spines; it was not dissected or X-rayed to determine the total count. Postel (1950) reported the count of 6 for 5 individuals of 687–832 SL. Radiographs of 34 specimens 80–440 mm SL were examined; in some individuals a terminal first dorsal spine which had not been detected by external examination was revealed. The first spine of some of the individuals with first dorsal counts of 8 was very small and also difficult to detect except in X-rays. The number of pterygiophores below the first dorsal spines also varied, but less frequently. All but two of the individuals with 8 spines had 2 above the first pterygiophore, and those with 7 had only 1 above this element. *S. carpenteri* is the only *Seriola* species with such variations in the verified (internal) counts of first dorsal spines and pterygiophores. In the other species, variations from their usual counts of 6, 7, or 8 spines are lacking, or so rare as to appear aberrant. No variations from the counts of 6 first dorsal pterygiophores for *S. quinqueradiata* and 7 for the other species have been noted. The 2 anterior spines of the anal fin of the largest

specimen examined (682 mm SL) had been absorbed into the body, as often occurs in large *Seriola* of other species.

The number of gill rakers also declined with growth of fish in the size range examined, as also occurs in other *Seriola* species. The highest numbers of gill rakers occurred in the 13 smallest individuals examined (80–100 mm SL), and the counts for these were 7–8 + 14–16 = 22–25, including one or two rudiments in 10 individuals. Probably smaller individuals than these have the above counts with fewer rudiments, or none. With growth of the fish, the rudiment often found at the anterior end of the upper limb disappears, but evidently there is no further degeneration of the upper rakers until SL exceeds 500 mm. Thus the decline in the total number of gill rakers with growth is due mainly to the degeneration of lower gill rakers, which is indicated by the decreasing raker count and the increasing number of rudiments on this limb. More examinations are needed to determine the usual count for large individuals, but the count of 6 + 16 = 22 given for 687–832 mm fish by Postel (1950) may be representative.

Measurements [% SL at 100 mm and 250 mm, from lines fitted visually to scatter diagrams for individuals 80–250 mm SL, and at 437 mm (holotype) and 682 mm, from measurements of individual specimens]: Head length 32.0, 31.0, 30.9, 28.6. Body depth 34.5, 32.8, 28.6, 25.4. Body width 15.7, 15.7, 14.6, 15.8. Depth of caudal peduncle 6.1, 5.3, 4.3, 4.1. Length of caudal peduncle 6.1, 6.5, 6.0, 6.3. Width of caudal peduncle 4.0, 6.0, 6.1, 5.8. Snout to insertion of first dorsal 40.0, 39.2, 40.0, 37.1. Snout to insertion of pelvic 35.0, 33.4, 32.7, 32.2. Snout to insertion of second dorsal 51.0, 51.0, 49.7, 46.3. Snout to insertion of anal 67.0, 64.0, 64.1, 62.7. Longest first-dorsal spine 6.8, 6.5, 6.3, 5.2. Length first-dorsal base 11.2, 11.8, 10.0, 8.7. Height of second dorsal 18.5, 17.5, 17.6, 15.4. Length of terminal second-dorsal ray 6.7, 6.7, 6.1, 5.1. Length of second-dorsal base 46.0, 46.0, 46.0, 44.8. Height of anal 13.9, 13.9, 13.8, 14.0. Length of terminal anal ray 6.8, 6.8, 6.7. Length of anal base 29.5, 29.5, 26.9, 26.6. Length of pectoral fin 17.0, 17.0, 17.5, 15.2. Length of pelvic fin 23.5, 22.0, 18.7, 17.1. Insertion of pelvic fin to vent 25.0, 25.0, 26.2, 24.6. Tip of pelvic fin to vent 0, 4.8, 6.2, at 7.5. Snout length 10.8, 10.8, 11.2, 10.7. Length of upper jaw 13.0, 13.0, 13.5, 12.8. Upper jaw reaches to vicinity of perpendicular through anterior edge of fleshy orbit in 80–100 mm specimens and usually to vicinity of perpendicular through middle of eye in larger specimens. Maximum vertical width of upper jaw 4.9, 4.9, 4.9, 4.9. Height of supramaxillary 1.5, 1.5, 1.5, 1.5. Width of fleshy interorbital 10.0, 10.0, 10.6, 9.4. Diameter of fleshy orbit 6.7, 6.7, 6.0, 4.8. Length of longest gill raker 4.7, 4.7, 5.1, 4.1.

Color: I have not observed the coloration of freshly caught specimens. Fowler (1919) stated "Color in alcohol brown above, paler below. Back with six pairs of close-set obscure deeper brown cross bars. Broad brown band from upper hind eye edge to spinous dorsal. Dorsals dusky or blackish-brown, paler basally on soft fin and edge broadly contrasted in young. Apex of soft dorsal pale or whitish. Anal pale brown with

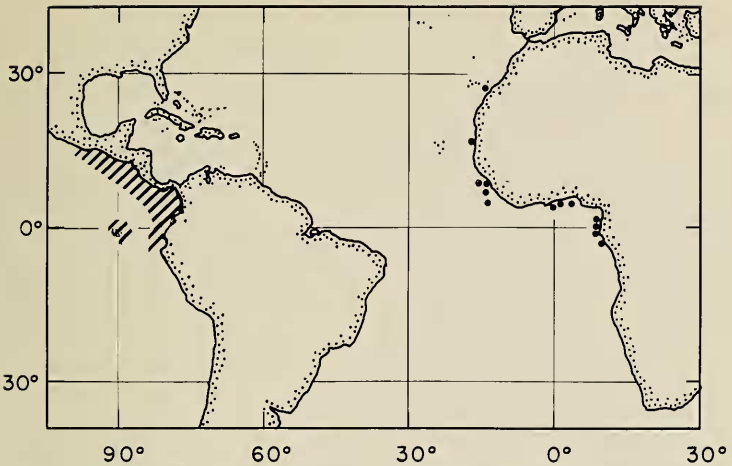

FIG. 2. Capture location records for *Seriola carpenteri* and known distributional range for *S. peruana*.

broad marginal dark band. Ventral blackish; rays and lower surfaces whitish. Pectoral and caudal brownish. Thirteen examples, 98 to 120 mm" (USNM 42320). Traces of this pattern remain in these specimens, and similar markings were observed in others up to 130 mm SL. There usually are six bands, with the last encircling the caudal peduncle. They are split and irregular, do not extend into the membranes of the second dorsal and anal fins, and become less distinct with increasing size of fish. The nuchal bar is variable, extending from the eye to the dorsal profile at a point varying between the origin of the first dorsal and a point halfway from there to the nape. The nuchal bar is lacking in preserved individuals over 200 mm long. Postel (1950) described the large specimens he examined as being old rose ("vieux rose"), fading to an indeterminable grey after 24 hours.

Distribution: *Seriola carpenteri* occurs off the tropical coasts of western Africa from 08°37′ S (Luanda, Angola) to 14°00′ N (Cape Verde), and a single specimen has been reported (as *S. dumerili*) from near Agadir, Morocco, (Furnestin et al., 1958: 447; herein identified from Fig. 51). Its distribution may be influenced by the seasonal movements of the 18°–27°C temperature fronts existing along the African coast (Longhurst, 1962). Postel (1950) reported that *S. lalandi* (actually *S. carpenteri*) occur off Cape Verde in the warm months, when the water temperatures exceed 25°C, only. The specimens from the Guinean Trawling Survey were taken in waters with surface temperatures of from 25°–30°C (Williams, 1968), except for one taken where the surface temperature was between 23° and 24°C. The surface temperatures of the waters frequented by *S. peruana*, along the American coasts from

TABLE 1. Frequency distributions for numbers of dorsal and anal soft rays for the 5 species of *Seriola* which occur in the eastern Atlantic (p = probability that *S. carpenteri* is indistinguishable from species listed on the basis of the respective characters).

Dorsal soft rays												
Species	27	28	29	30	31	32	33	34	35	$\bar{x}$	n	p
S. carpenteri		3	5	9	12	7	1			30.5	37	
S. dumerili			7	27	63	72	35	19	1	31.7	224	.02
S. rivoliana	4	12	29	34	16	1	3			29.6	99	.10
S. fasciata		3	12	22	19	15	1			30.5	72	>.50
S. lalandi				2	5	6	4	6		32.3	23	.01

Anal soft rays										
Species	17	18	19	20	21	22	$\bar{x}$	n	p
S. carpenteri			10	27			19.7	37	
S. dumerili		5	47	103	45	2	20.0	202	>.50
S. rivoliana		1	15	50	24	4	20.2	94	.10
S. fasciata	3	10	39	14			19.0	66	.05
S. lalandi			8	11	3	1	19.9	23	>.50

Peru to the Gulf of Tehuantepec and around the Galapagos Islands, also generally exceed 25°C. The habitats of the two species are quite similar in this respect as well as being located in nearly the same latitudes on the eastern sides of the respective oceans and being enriched by upwelling.

Etymology: This species is named for my friend William K. Carpenter of Fort Lauderdale, Florida. Mr. Carpenter, an outstanding big game fisherman, has long been the President and leading sponsor of the International Game Fish Association. His dedicated support of marine science includes generous financial contributions and outstanding personal participation in research activities.

Differentiation from other species: Zoogeographically, *S. carpenteri* is closely equivalent to *S. peruana* of the eastern tropical Pacific. Although these species are superficially similar, *S. peruana* has more numerous gill rakers (29–33 against 20–25) and a shorter snout (8.7–10.4, average 9.2, against 9.6–11.6, average 10.8% SL). These species share a juvenile characteristic (distinctive up to about 190 mm SL for *S. carpenteri*, possibly to somewhat smaller sizes for *S. peruana*)—predominantly dark membranes of the soft dorsal and anal fins—which has not been observed in any of their congeners. Juvenile *S. hippos* have not been examined. Juvenile Atlantic *S. lalandi* have likewise not been described, but the soft dorsal and anal membranes of eastern Pacific specimens are only lightly pigmented.

Of the seven other *Seriola* species, three are extralimital to *S. carpen-*

TABLE 2. Frequency distribution of number of gill rakers (total on first arch including rudiments), for species of *Seriola* occurring in the eastern Atlantic. All counts are from Atlantic or Mediterranean specimens except Pacific S. *lalandi*. Numbers for the first 4 *Seriola* species and Pacific specimens of S. *lalandi* are from specimens of 50–100 mm SL; numbers for S. *lalandi* from the Atlantic are from specimens of 300–499 mm. (p = probability that S. *carpenteri* is indistinguishable from species listed on the basis of this character.)

	Gill rakers											
Species	21	22	23	24	25	26	27	28	29	$\bar{x}$	n	p
S. *carpenteri*		2	4	5	1	1				23.6	13	
S. *dumerili*	4	8	9	1						22.3	22	.05
S. *rivoliana*					1	7	8	1		26.5	17	<.01
S. *fasciata*			1	2	6	1				24.7	10	.10
S. *lalandi* (Pacific)							3	2	3	28.0	8	<.01
S. *lalandi* (Atlantic)				2			5	1	1	26.7	9	<.01

teri. These differ from S. *carpenteri* as follows. S. *quinqueradiata* (western North Pacific) has more gill rakers (29–34 against 20–25), one more supraneural (4 against 3), fewer first dorsal spines (6 against 7 or 8), fewer pterygiophores below the first dorsal spines (6 against 7 or 8) and a different vertebral count distribution (11 + 13 against 10 + 14). S. *hippos* (Australia and vicinity) has fewer gill rakers and dorsal and anal soft rays (11–13, 22–25 and 16–17 against 20–25, 28–33, and 19–20, respectively). S. *zonata* (western Atlantic) has a shorter anal base (22 against 27–29% SL). S. *zonata* also has a distinctly different color pattern in the smaller sizes, with prominent solid dark bands, some of which extend into the membranes of the soft dorsal and anal fins, in contrast to the much less distinct irregular bands of S. *carpenteri*, none of which extend into the membranes of the above fins. The vertebral counts are 11 + 13 for S. *zonata* and 10 + 14 for S. *carpenteri*.

The remaining four *Seriola* species, S. *fasciata* (western Atlantic, rarely in eastern Atlantic), S. *lalandi* (southern hemisphere, also eastern and western coasts of the North Pacific), S. *rivoliana* (circumglobal) and S. *dumerili* (nearly circumglobal) (Mather, 1958), have been recorded from the eastern Atlantic, and may occur within the range of S. *carpenteri*. S. *carpenteri* may have either 7 or 8 first dorsal spines, whereas S. *fasciata* consistently has 8 and the other three species consistently have 7. Thus S. *carpenteri* with the more usual count of 8 may be separated from S. *dumerili*, S. *rivoliana* and S. *lalandi*, and those with the less frequent count of 7 can be separated from S. *fasciata*, which evidently is very rare in the eastern Atlantic. As noted previously, internal examination may be necessary to establish this count, especially in large individuals. The numbers of dorsal and anal soft rays (Table 1) show modal differences,

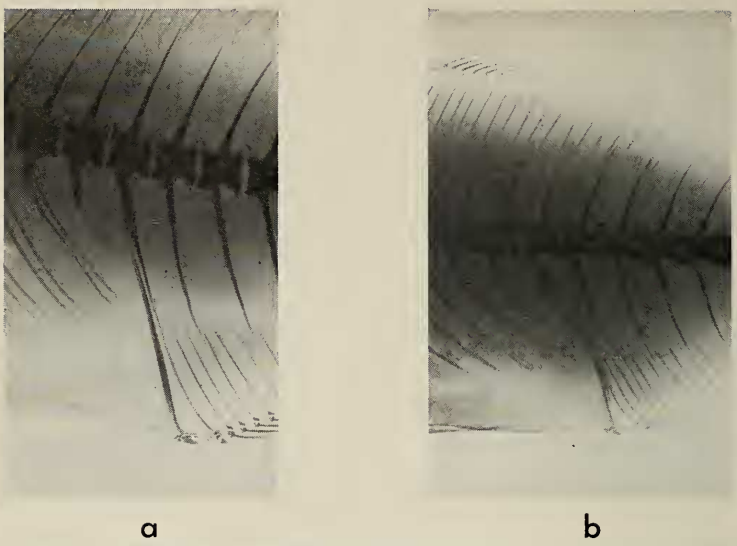

Fig. 3. X-rays of first anal pterygiophores of (a) *Seriola rivoliana* (228 mm specimen from Terceira, Azores, USNM 94489) and (b) *S. carpenteri* (190 mm specimen from 04°55′ S, 11°38′ E, WHOI, F. J. Mather No. 454).

but the dorsal count of *S. lalandi* is the only one which is distinguishable from the corresponding count of *S. carpenteri* at a confidence level of 1 percent. *S. rivoliana* differs at this level in gill raker count for small individuals (Table 2) from *S. carpenteri*, and *S. lalandi* does also if the count for small eastern Pacific individuals is typical of those in the Atlantic. Since no small Atlantic *S. lalandi* have been examined, counts for small eastern Pacific specimens, and for larger Atlantic specimens (300–499 mm SL) are shown. Large (over 500 mm SL) *S. dumerili* have fewer functional gill rakers (usually 3 upper and 10 lower) than were found in a 682 mm specimen of *S. carpenteri* (7 upper and 14 lower) or reported by Postel (1950) (6 upper and 16 lower) for five large specimens (687–832 mm). *S. lalandi* has 1 more vertebra ($11 + 14 = 25$) than the other four eastern Atlantic species ($10 + 14 = 24$).

In specimens longer than 80 mm SL, the configuration of the first anal pterygiophore of *S. rivoliana* differentiates it from *S. carpenteri* and its other congeners. It is straight in the former (Fig. 3a), and distinctly curved in *S. carpenteri* (Fig. 3b) and the others.

S. carpenteri also differs from its four sympatric congeners in several morphometric characters, although there is some overlapping, especially at the smallest and largest sizes. The head of *S. carpenteri* is longer (30% SL 80–437 mm, 28.6% at 682 mm) than that of *S. lalandi*

(27% SL). The body depth of S. *carpenteri* (34% SL 80–150 mm, decreasing to 33% at 250 mm; 28.5% at 437 mm; 25.8% at 682 mm) is greater than that of S. *lalandi* (25% SL at 300 mm, 23.2% at 700 mm) and less than those of S. *rivoliana* (39% SL 50–270 mm, decreasing to 34% at 450 mm and 31% at 700 mm) and S. *fasciata* (39% SL 50–185 mm, decreasing to 32% at 300 mm). The height of its second-dorsal fin (17.5–20.0% SL) is less than that of S. *rivoliana* (18.0–25.0% SL), but greater than those of the other three species (12.8–19.0% SL). The intermediate development of this fin is shown more vividly in the photograph of a 602 mm TL specimen (Furnestin et al., 1958, Fig. 51) than in any of the specimens examined. The height of the anal fin of S. *carpenteri* is also less than that of S. *rivoliana* but greater than those of the other species. The longest gill raker of S. *carpenteri* (about 5.2% SL at all sizes) is longer than those of the four other species (about 2.3–4.5% SL).

The color pattern of young 80–120 mm specimens as described by Fowler and observed on our material is generally similar to S. *dumerili* and S. *rivoliana*. The second dorsal and anal webs, however, are predominantly dark, a characteristic which it shares in the genus only with its eastern Pacific counterpart, S. *peruana*. The pattern of young S. *carpenteri* also differs distinctly from those of S. *fasciata* and S. *lalandi* in other respects. Both of the latter have more numerous bands, those of the first extend into the webs of second-dorsal and anal fins, the nuchal bar of S. *fasciata* curves upward to the nape, and S. *lalandi* has no nuchal bar at all. In small S. *carpenteri*, the nuchal bar is variable, extending from the eye to the origin of the first dorsal fin in some individuals, as in small S. *dumerili* and S. *rivoliana*, and curving toward a point nearer the nape in others, somewhat as in small S. *fasciata*. Postel's (1950) description and my observations indicate that the nuchal bar in large S. *carpenteri* is less persistent than in large S. *dumerili* and S. *rivoliana*.

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Literature Cited

Cadenat, J. 1950. Poissons de mer du Sénégal. Initiations Africaines III, Inst. Fr. Afr. Noire, Dakar: 1–345.

Fowler, H. W. 1919. Fishes of the U.S. *Eclipse* expedition to west Africa. Proc. U.S. Nat. Mus., 56(2294): 195–292.

———. 1936. The marine fishes of west Africa. Bull. Amer. Mus. Nat. Hist., 70(Pt. 2): 607–1493.

Furnestin, J., J. Dardignac, D. Maurin, A. Vincent, R. Coupé, H. Boutière. 1958. Données nouvelles sur les poissons du Maroc atlantique. Rev. Trav. Inst. Pêches Marit., 22(4): 379–493.

Hubbs, C. L. and K. T. Lagler. 1958. Fishes of the Great Lakes Region. Cranbrook Inst. Sci. Bull., 26: 186 pp.

Longhurst, A. R. 1962. A review of the oceanography of the Gulf of Guinea. Bull. Inst. Fr. Afr. Noire, Dakar, Tome XXIV, sér. A. No. 3: 633–663.

Marr, J. C. and M. B. Schaefer. 1949. Definitions of body dimensions used in describing tunas. U.S. Fish Wildlife Serv. Fish. Bull. 47, vol. 51: 241–244.

Mather, F. J., III. 1958. A preliminary review of the amberjacks, genus *Seriola*, of the western Atlantic. Intern. Game Fish Conf., Intern. Oceanogr. Found. and Gulf Carib. Fish. Inst., Miami Beach, Florida, November 19, 1958, 12 pp.

Postel, E. 1950. Pêche sur les côtes d'Afrique occidentale. II. Poissons de surface. Dakar: 1–77.

Williams, F. 1968. Report on the Guinean Trawling Survey. Org. Afr. Unity. Sci. Techn. Res. Commission P.B.M. 2359, 3 vols.